

# इंटरनेट

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IS 3626 (2001): Locked Coil Winding Ropes [MED 10: Wire Ropes and Wire Products]



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भारतीय मानक  
लॉक कुंडली वेष्टित तारें — विशिष्टि  
( दूसरा पुनरीक्षण )

*Indian Standard*

LOCKED COIL WINDING ROPES — SPECIFICATION  
( *Second Revision* )

ICS 73.100.40; 77.140.65

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**BUREAU OF INDIAN STANDARDS**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

## FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Wire Ropes and Wire Products Sectional Committee ME 10 had been approved by the Mechanical Engineering Division Council.

This standard was first issued in 1966 and revised in 1978. The experience gained in the implementation of this standard since its issue necessitated the first present revision. The tensile designation of wires was suitably modified and the requirements pertaining to round wires have been deleted and reference made to IS 1835. In the present revision breaking force and mass for ropes have been modified and additional popular sizes of ropes have also been added.

Locked coil winding ropes are essentially smooth surface ropes, composed of shaped wires laid in concentric layers around a centre of round wires. Locked coil ropes are being increasingly used in mining because of their inherent superiority over the usual stranded wire ropes.

While preparing this standard assistance has been derived from NCB Specification No. 186/1970 'Locked coil winding ropes' issued by National Coal Board, UK.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

# Indian Standard

## LOCKED COIL WINDING ROPES — SPECIFICATION ( Second Revision )

### 1 SCOPE

It covers locked coil wire ropes used for winding purposes in mines.

### 2 REFERENCES

The following standards contain provisions, which through reference in this text constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
1608 : 1995	Mechanical testing of metals — Tensile testing ( <i>second revision</i> )
1716 : 1985	Method for reverse bend test for metallic wire ( <i>second revision</i> )
1717 : 1985	Method for sample test for wire ( <i>second revision</i> )
1835 : 1976	Round steel wire for ropes ( <i>third revision</i> )
6594 : 1977	Technical supply conditions for steel wire ropes and strands ( <i>first revision</i> )

### 3 TERMINOLOGY

For the purpose of this standard the terms given in IS 2363 shall apply.

### 4 DIMENSIONS

#### 4.1 Size

The size of the rope shall be expressed in terms of the nominal diameter and it shall be one of those diameters mentioned in Table 1. Interpolation, however, of the values given in Table 1 for mass and minimum breaking force shall be permitted for ropes of intermediate sizes.

#### 4.2 Length

The rope shall not be less than the length specified by the purchaser nor shall it exceed the specified length by more than 2.5 percent.

### 5 MATERIAL

**5.1** The wires shall be cold drawn from steel made by the open hearth, electric, duplex, basic oxygen or a combination of these processes.

**5.2** If required, the manufacturer shall furnish the steel maker's cast analysis to the purchaser and issue a certificate to him that the wires have been drawn from the certified steel.

**5.3** The chemical composition of the steel wires shall be as given in Grades 1, 2 and 3 in IS 1835.

#### 5.4 Tensile Designation of Wire

The tensile designation of wire, shall be as given below:

<i>Round Wires</i>	<i>Shaped Wires</i>
1 570	1 230
1 770	1 420
1 960	1 570

**5.4.1** The tensile range of round wires shall be as given in IS 1835. The tensile range of shaped wires shall be as given below:

<i>Tensile Designation</i>	<i>Tensile Range N/mm<sup>2</sup></i>
1 230	1 230-1 430
1 420	1 420-1 620
1 570	1 570-1 770

**5.5** The wires may be supplied in any one of the following conditions as specified by the purchaser:

- Ungalvanized, and
- Galvanized.

If galvanized wire is required, the minimum mass of the coating on the wire shall be 45 g/m<sup>2</sup> of surface area for the shaped wire, and 65 g/m<sup>2</sup> for the round wire.

### 6 BREAKING FORCE AND MASS

Breaking force and mass shall be as given in Table 1.

### 7 MANUFACTURE

#### 7.1 Construction

The rope shall consist of an outer layer of shaped wires with inner layers of either a combination of shaped

Table 1 Mass and Breaking Force of Locked Coil Wire Ropes  
(Clauses 4.1, 6 and 10.3)

Nominal rope diameter	: d
Mass factor (K)	: 0.553 8
Rope mass (kg/100 m)	: $Kd^2$
Breaking force factor (K')	: 0.553 6
Rope grade (R0)	: 1 470 N/mm <sup>2</sup>
Minimum breaking force of rope = $(K'R^2d^2)/1\ 000$ kN	

Nominal Rope Diameter	Rope Mass	Minimum Breaking Force of Rope
(d)		
in mm	in kg//100 m	in kN
+2%	± 4%	
-1%		
(1)	(2)	(3)
16	142	208
18	179	264
19	200	294
20	222	326
21	244	359
22	268	394
24	319	469
25	346	509
26	375	550
27	404	593
28	434	638
29	466	685
30	499	733
32	567	834
34	640	941
35	679	997
36	718	1 055
37	758	1 114
38	800	1 176
39	843	1 238
40	886	1 303
41	931	1 368
44	1 073	1 576
46	1 172	1 723
48	1 276	1 876
51	1 441	2 117
54	1 615	2 374
57	1 800	2 645
60	1 994	2 931

NOTES

- 1 The calculated aggregate breaking force of the rope may be obtained by multiplying the values in col 3 by 1.16.
- 2 The rope mass values are given for lubricated ropes. Lubricated ropes are weighing approximately 1 percent more than the unlubricated ropes.

and round wires or round wires over a core. The manufacturer shall make available to the purchaser, on request , the details of construction, including the approximate length of the lay.

7.2 Wire Tensile Designation

To produce the required rope breaking forces the manufacturer may employ any combination of tensile designations for round and shaped wires given in 5.4 provided that all the round wires of same size in any one layer in the rope are of one tensile designation

while all the shaped wires of same size in one layer in the rope are of one tensile designation.

8 LUBRICATION

8.1 The rope shall be thoroughly lubricated internally and externally during manufacture. The lubricant shall meet the requirements laid down in IS 6594. Lubrication of ropes for friction winders and other special applications shall be a subject of special agreement between the purchaser and the manufacturer.

9 TEST ON WIRES USED BY THE ROPE MANUFACTURER (BEFORE ROPE MAKING)

9.1 Each coil of wire used in the manufacture of rope shall be subjected to tensile, torsion and reverse bend tests. The test results shall be recorded and made available for inspection by the purchaser or his representatives at the rope manufacturer’s works. The tests shall be carried out as given in 9.1.1 to 9.1.3.

9.1.1 Tensile Test

The tensile test shall be carried out in accordance with IS 1608 except that in the case of shaped wires, the tensile strength shall be calculated from the breaking force and the ‘equivalent round section’, that is, the round wire of equal cross-sectional area to that of the shaped wire (see Annex A). The equivalent round section for the particular wire shall be provided by the manufacturer, on request. The wires shall comply with the requirements shown in 5.4.1.

9.1.2 Torsion Test

The wires shall be tested in accordance with IS 1717 except that in the case of shaped wires, the test length of the shaped wire shall be 100 × altitudes or 200 mm as may be agreed (see Fig. 1). In the shorter test lengths, the minimum number of twists shall be taken directly proportional to the number specified for the test length of 100 × altitude. The torsion testing machine shall have adequate provision for applying back tension to the wire for allowing lateral movement of one of the gripping heads. The torsion values obtained shall not be less than those specified (under before rope making) in Table 2.

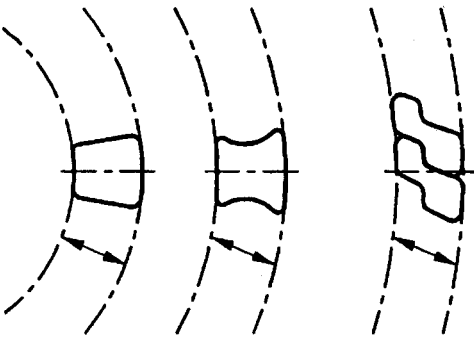


FIG. 1 ALTITUDE OF SHAPED WIRES

Table 2 Torsion Test for Shaped Wires  
(Clauses 9.1.2 and 10.2.2)

Nominal Altitude of Wire	Minimum Number of Torsion on a Length of 100 × Altitude							
	Tensile Designation 1230 and 1420				Tensile Designation 1570			
	Before rope making		From completed rope		Before rope making		From completed rope	
	Ungalva- nized	Galva- nized	Ungalva- nized	Galva- nized	Ungalva- nized	Galva- nized	Ungalva- nized	Galva- nized
Full lock wires								
3.55 mm and greater	26	23	19	17	24	21	18	15
Smaller than 3.55 mm	28	25	21	18	26	23	19	17
Half lock wires								
2.75 mm and greater	25	22	18	16	23	20	17	15
Smaller than 2.75 mm	27	24	20	18	25	22	18	16

9.1.3 Reverse Bend Test

The reverse bend test shall be carried out in accordance with IS 1716 except that in the case of the shaped wires, the wires shall be placed in the bending machine with the waist facing the mandrel, that is, the shaped wires shall be bent over the waist (see Fig. 2). The values obtained shall not be less than those specified in Table 3.

10 TESTS ON COMPLETED WIRE ROPES

10.1 When specified by the purchaser, inspection and testing of completed wire ropes and wires from a completed rope shall be carried out at the works of the rope manufacturer. The manufacturer shall supply all the necessary test samples, machinery, apparatus and the labour required for inspection and testing at

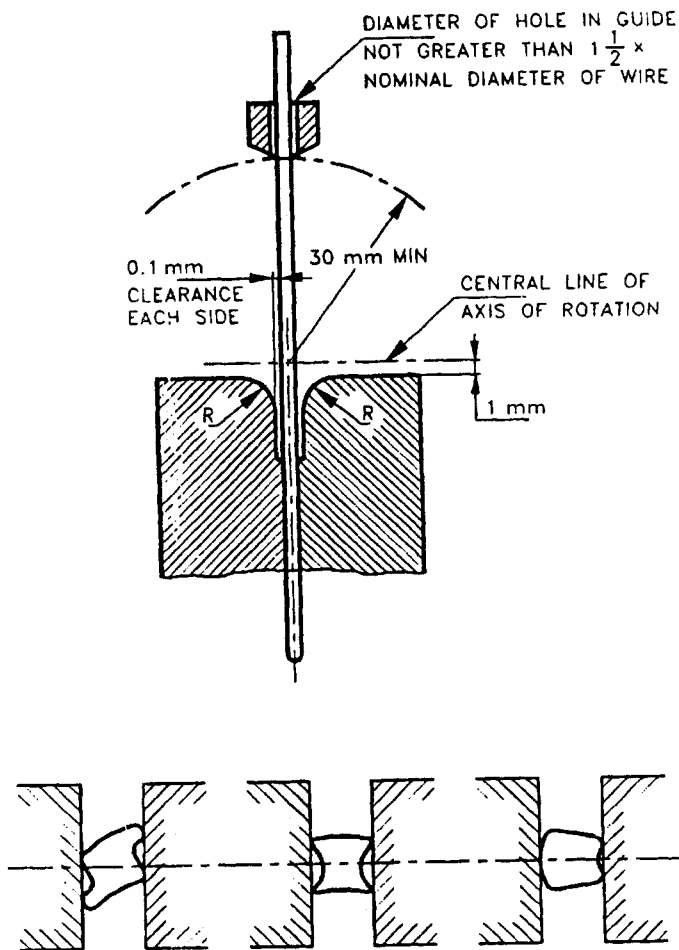


FIG. 2 BEND TEST FOR SHAPED WIRES



**Table 3 Reverse Bend Test for Shaped Wires ( Before Rope Making)**

(Clause 9.1.3)

Nominal Altitude mm		Diameter of Bending Roller mm	Minimum Number of Bends Tensile Designation of Wire							
Over	Up to and Including		1230 and 1420				1570			
Full Lock Wires			Ungalvanized	Galvanized		Ungalvanized		Galvanized		
1.27	1.52	10	20	18		18		16		
1.52	1.78	10	18	16		16		14		
1.78	2.03	10	16	14		14		12		
2.03	2.29	10	15	13		13		11		
2.29	2.54	10	13	11		11		10		
2.54	2.79	10	10	9		9		8		
2.79	3.05	15	15	16		16		14		
3.05	3.30	15	16	14		14		12		
3.30	3.56	15	12	10		10		9		
3.56	3.81	15	10	9		8		7		
3.81	4.06	20	11	10		10		9		
4.06	4.32	20	10	9		9		8		
4.32	4.57	20	9	8		8		7		
Half Lock Wires			Nar- row	Broad	Nar- row	Broad	Nar- row	Broad	Nar- row	Broad
1.27	1.52	10	18	15	17	14	17	14	16	13
1.52	1.78	10	16	13	15	12	14	12	13	11
1.78	2.03	10	14	12	13	11	13	11	11	10
2.03	2.29	10	11	9	10	8	10	8	9	7
2.29	2.54	10	10	8	9	7	9	7	8	6
2.54	2.79	15	13	9	11	8	11	8	10	7
2.79	3.05	15	12	9	10	8	10	8	9	7
3.05	3.30	15	11	8	10	7	10	7	8	6

NOTE — The description 'broad section' shall apply to half-locked wires when the ratio of nominal altitude to minimum waist dimension is not more than 1.5 to 1. Where the ratio is greater, the description 'narrow section' shall apply.

his works. All the tests shall be under the direction of the purchaser or his representatives.

The test to be carried out shall be:

- tensile, torsion and reverse bend tests on wires taken from the sample of the completed rope; and
- breaking force test.

## 10.2 Test on Wires from the Completed Rope

A suitable length from the manufactured rope shall be cut. The wires of each layer shall be separated and wires of each type and size shall then be segregated into groups and the wires in each group are well mixed. A quarter of each group shall then be subjected to tensile, torsion and reverse bend tests in accordance with the procedure laid down in 9.1.

**10.2.1** The tensile strength of the wires removed from the completed rope shall not be more 50 N/mm<sup>2</sup> below

the minimum value of the tensile designation specified and the difference in tensile strength between the maximum and minimum tensile values of wires tested shall not exceed 240 N/mm<sup>2</sup>.

### 10.2.2 Torsion Test

The round wires shall comply with the appropriate requirement of IS 1835 except that the minimum number of torsion may be 75 percent (to the nearest whole number) of those specified therein. The torsion value of the shaped wires shall comply with those specified (under completed rope) in Table 2.

### 10.2.3 Reverse Bend Test

The round wires shall comply with the appropriate requirement of IS 1835 except that the minimum number of reverse bends may be 75 percent (to the nearest whole number) of those specified therein. The reverse bend value of the shaped wires shall comply with that specified in Table 4.

**Table 4 Reverse Bend Test for Shaped Wires (from Completed Rope)**  
(Clause 10.2.3)

Nominal Altitude mm		Diameter of Bending Roller mm	Minimum Number of Bends Tensile Designation of Wire							
Over	Up to and Including		1230 and 1420				1570			
Full Lock Wires			Ungalvanized	Galvanized		Ungalvanized		Galvanized		
1.27	1.52	10	15	14		14		13		
1.52	1.78	10	13	12		12		12		
1.78	2.03	10	12	11		11		10		
2.03	2.29	10	11	10		10		9		
2.29	2.54	10	9	9		9		8		
2.54	2.79	10	7	6		6		6		
2.79	3.05	15	13	12		12		11		
3.05	3.30	15	12	10		10		9		
3.30	3.56	15	9	7		7		6		
3.56	3.81	15	7	6		6		5		
3.81	4.06	20	8	7		7		6		
4.06	4.32	20	7	6		6		6		
4.32	4.57	20	6	6		6		5		
Half Lock Wires			Nar- row	Broad	Nar- row	Broad	Nar- row	Broad	Nar- row	Broad
1.27	1.52	10	13	11	12	10	12	10	12	9
1.52	1.78	10	12	9	11	9	10	9	9	8
1.78	2.03	10	10	9	9	8	9	8	8	7
2.03	2.29	10	8	6	7	6	7	6	6	5
2.29	2.54	10	7	6	6	5	6	5	6	4
2.54	2.79	15	9	6	8	6	8	6	7	5
2.79	3.05	15	9	6	7	6	7	6	6	5
3.05	3.30	15	8	6	7	5	7	5	6	4

NOTE — The description 'broad section' shall apply to half-locked wire when the ratio of nominal altitude to minimum waist dimension is not more than 1.5 to 1. Where the ratio is greater, the description 'narrow section' shall apply.

#### 10.2.4 Retest

If two or more wires fail to pass the tensile, torsion and reverse bend tests specified, retest limited to the type of test under which the failure occurred, shall be carried out. If under the retest, two or more wires fail in any type of test, the rope represented by the sample shall be considered not to comply with this specification.

#### 10.3 Breaking Force Test

The rope shall be tested to destruction for determining the breaking force of the rope in the manner described in IS 6594. This test may be carried out by an independent organization, if desired by the purchaser. The breaking force of the rope shall not be less than the value specified in Table 1.

### 11 INDEPENDENT TESTS ON COMPLETED ROPE

11.1 If the purchaser is not satisfied with the tests, the

manufacturer shall be at liberty to have independent tests carried out by a test authority to be agreed upon between the purchaser and the manufacturer. If the test results meet the requirements of this specification, the rope shall be deemed to comply with the specification.

11.2 Such independent test shall be carried out in accordance with the provisions of this standard.

### 12 CERTIFICATE OF COMPLIANCE

With each reel of completed rope the manufacturer shall supply a certificate of test. The form of the certificate shall be as shown in Annex C of IS 6594.

### 13 PACKING

13.1 The rope shall be supplied on reels having a sufficient belly diameter to prevent damage through permanent set to the rope.

13.2 The rope shall be suitably protected on the reel to avoid damage in transit and corrosion.

**14 INFORMATION TO BE GIVEN WITH THE ENQUIRY OR ORDER**

All the necessary information regarding the conditions under which the rope is to be used, together with other particulars as laid down in Annex B, shall be supplied with the enquiry or order.

**15 INFORMATION TO BE GIVEN BY THE MANUFACTURER**

If required, the manufacturer shall supply information regarding the construction of the rope, as laid down in Annex C.

**ANNEX A**  
*(Clause 9.1.1)*

**METHOD OF CALCULATION OF EQUIVALENT ROUND SECTION OF A SHAPED WIRE**

**A-1** Prepare an exact length of wire equal to 150 mm, with the ends filed flat, clean and weigh accurately.

$$\begin{aligned} \text{Area in mm}^2 &= \text{mass in g} \times 0.85 \\ \text{Diameter of equivalent round section in mm} &= \sqrt{\text{mass in g} \times 1.081} \end{aligned}$$

**ANNEX B**  
*(Clause 14)*

**INFORMATION TO BE GIVEN WITH THE ENQUIRY OR ORDER WHEN NECESSARY**

**B-1** The following information shall be given, when necessary, with the enquiry or order:

- a) Particulars of shaft
  - i) Depth from lowest working level in shaft to bank, vertical distance from bank to centre of head pulley;
  - ii) Whether upcast or downcast;
  - iii) Whether wet or dry, and approximate range of temperature variation; and
  - iv) Whether there are any special circumstances likely to affect the rope like sand stowing, alkaline or acidic water, etc.
- b) Particulars of winding engine drum
  - i) Type of drum
    - 1) If parallel type, give diameter and width, and distance of first and last five turns from centre line of the drum.
    - 2) If conical type, give minimum and maximum diameters and width and distance of first and last working

- turns from centre line of drum; and
- 3) If cylindro-conical type, give maximum and minimum diameters, distance of first and last five turns from centre line of drum, number of working turns on the minimum diameter, number of turns on the scroll, width of drum and width of scroll and width of parallel portion of drum.
  - ii) Nature and arrangement of drum-lagging or cleaning material and particulars of any grooving;
  - iii) Whether rope is wound on itself and if so, number of layers.
- c) Particulars of driving sheave
  - i) Diameter
  - ii) Rope groove-lining
- d) Particulars of pithead pulleys and position with respect to the winding engine:
  - i) Horizontal and vertical distance between

centres of pithead pulleys and whether the vertical centre line or between the pulleys coincides with the centre line of the drum or sheave;

- ii) Diameter of pithead pulley at bottom of groove;
  - iii) Diameter of any guide sheave and its position with respect to the pithead pulley or driving sheave;
  - iv) Height of centre head pulley above centre of drum or ground type driving sheave;
  - v) Horizontal distance between centre of drum or ground type driving sheave and rope hanging in shaft; and
  - vi) Inside and outside fleet angles.
- e) Maximum winding speed in m/s,
  - f) Maximum acceleration in  $\text{m/s}^2$ , when raising full load
  - g) Maximum load and normal load suspended from the winding rope capping including the mass of any balance rope and its attachment.
  - h) Type of cage guides.
  - j) Particulars of rope required or proposed
    - i) Length in metres,
    - ii) Nominal diameter,
    - iii) Construction,
    - iv) Minimum breaking force in kN,
    - v) Nominal tensile designation of wires, and
    - vi) Whether the wire is to be galvanized or ungalvanized.
  - k) Particulars of inspection and testing required.

## ANNEX C

(Clause 15)

### INFORMATION TO BE GIVEN BY THE MANUFACTURER

**C-1** The following information is to be given by the manufacturer, if required:

- a) Quality of material, and nominal tensile designation of wire in each layer;
- b) Nominal diameter of rope;
- c) Details of construction:
  - i) Number and altitude of shaped wires in outer layers,
  - ii) Number and altitude/diameter of shaped/round wires in other layers,
  - iii) Equivalent round section of shaped wires;
- d) Approximate mass in kg/100 m of rope;
- e) Minimum breaking force of rope in kN;
- f) Approximate mass of rope as packed for transit;
- g) Length of rope;
- h) Date of manufacture; and
- j) Identification number.

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of ‘BIS Handbook’ and ‘Standards: Monthly Additions’.

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**Amendments Issued Since Publication**

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**BUREAU OF INDIAN STANDARDS**

**Headquarters:**

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002  
Telephones: 323 01 31, 323 3375, 323 94 02

Telegrams: Manaksanstha  
(Common to all offices)

**Regional Offices:**

Telephone

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg  
NEW DELHI 110002

323 76 17, 323 38 41

Eastern : 1/14 C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi  
CALCUTTA 700054

{ 337 84 99, 337 85 61  
337 86 26, 337 91 20

Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022

{ 60 38 43  
60 20 25

Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113

{ 235 02 16, 235 04 42  
235 15 19, 235 23 15

Western : Manakalaya, E9 MIDC, Marol, Andheri (East)  
MUMBAI 400093

{ 832 92 95, 832 78 58  
832 78 91, 832 78 92

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